2nd Annual NASA/JPL
Small Business Symposium
& Awards Ceremony

NASA Aeronautics Research

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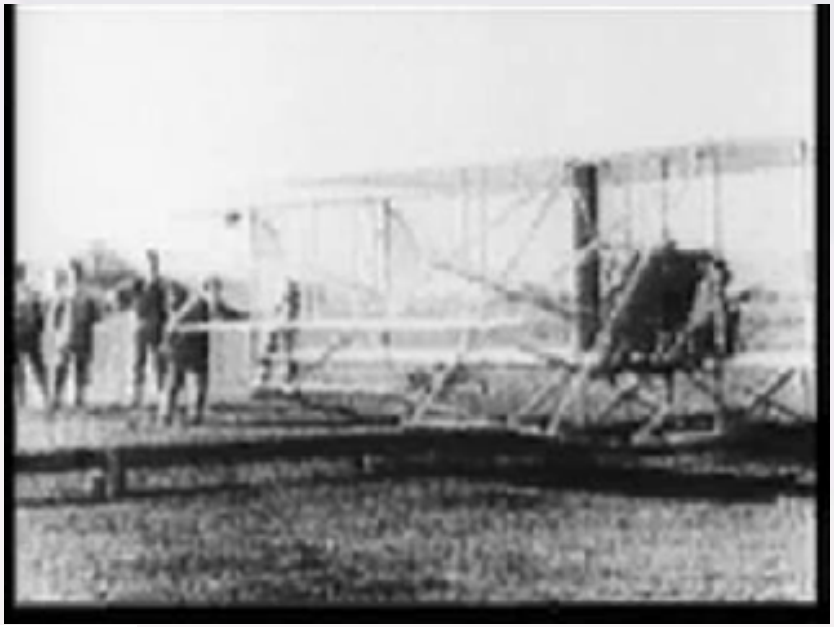
Wright Brothers to Thousands of Airplanes

On December 17, 1903, Orville and Wilbur Wright, bicycle mechanics by profession and aeronautical pioneers by hobby, prepared their frail wood and fabric machine for flight. The airplane would fly for 12 seconds and 120 feet that day.



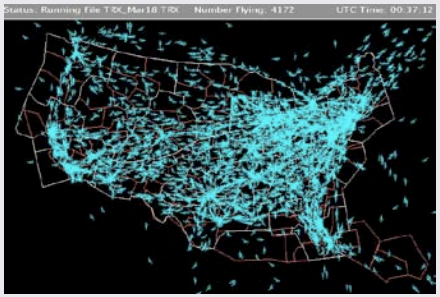
24 Hours in U.S. Airspace System

Roughly 5000 scheduled commercial flights at peak hours

Aviation's Economic Impact

Impact of Aviation

- Manufacturing and services account for $436 billion in direct economic activity
- Provides $60.6B positive trade balance
  - Reduces the total negative trade balance by 8%
- 25% of all companies' sales depend on air transportation
- 655,500 jobs in the U.S. Aviation Industry
  - 490,300 domestic manufacturing
  - 165,200 air transportation services
- 650 million travelers annually (~ 2 million travelers/day)
  - 151 domestic airlines flying 8,100 aircraft
  - Airline annual operating revenue is $143B
- 51,000 controlled domestic flights/day
  - 38,000 commercial or air taxi flights
  - FAA simultaneously controls over 4,000 flights for most of the day



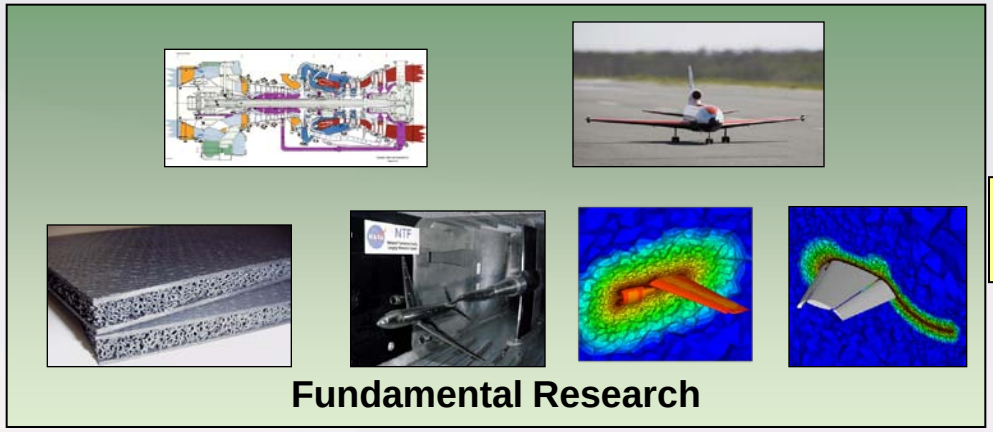
Aviation has a huge impact on the nation's economy and touches most of the general public/taxpayers

NASA Aeronautics Investment Strategy

"Seedling" Fund for New Ideas

System Level Research

Tech. Transfer



Fundamental Research

Tech. Transfer

Enabling "Game Changing" concepts and technologies from advancing fundamental research ultimately to understand the feasibility of advanced systems

NASA Aeronautics Portfolio in FY2010



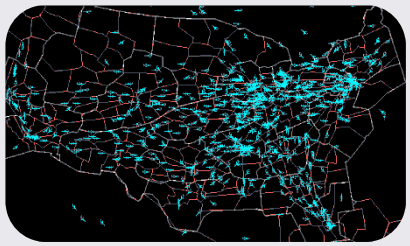
Fundamental Aeronautics Program

Conduct cutting-edge research that will produce innovative concepts, tools, and technologies to enable revolutionary changes for vehicles that fly in all speed regimes.

Integrated Systems Research Program

Conduct research at an integrated system-level on promising concepts and technologies and explore/assess/demonstrate the benefits in a relevant environment



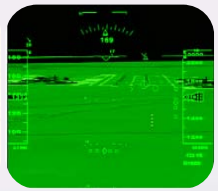


Airspace Systems Program

Directly address the fundamental ATM research needs for NextGen by developing revolutionary concepts, capabilities, and technologies that will enable significant increases in the capacity, efficiency and flexibility of the NAS.


Aviation Safety Program

Conduct cutting-edge research that will produce innovative concepts, tools, and technologies to improve the intrinsic safety attributes of current and future aircraft.



Aeronautics Test Program

Preserve and promote the testing capabilities of one of the United States' largest, most versatile and comprehensive set of flight and ground-based research facilities.

NextGen – National Challenge

Today's national airspace system is constrained

Demand/Capacity

- Capacity is limited by controller workload
- System is near maximum capacity given today's procedures.
- Demand could increase by more than two times by 2025 in a favorable economic environment

Delays

- Delays are up 20% since 2006 due to capacity constraints
- Uncertainties and operational perturbations automatically cause delay

Scalability

- Impractical to add more sectors in a human-centric system with limited automation.

Environment

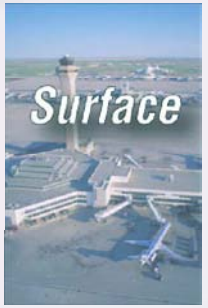
- Rising fuel concerns
- Increased noise
- Increased emissions

NextGen – NASA Aeronautics' contribution

Developing integrated systems solutions essential to attaining the NextGen vision

Creating technologies and operational concepts that enable better use of existing capacity with current generation and advanced aircraft. NASA research provides the foundation for government and industry to transition technology and concepts to NextGen.

- **Enroute/Oceanic Operations**: Developing methods to manage air traffic flows throughout the entire system in a holistic manner, optimizing the national airspace system
- **Super Density Operations**: Enabling the most efficient use of constrained airspace by managing congested, complex flows in a region as well as at a single airport
- **Arrival/Departure/Surface Operations**: Integrating runway and surface operations, and developing optimized solutions for airport traffic management
- **Advanced Vehicle Systems**: Developing new aircraft concepts and technologies that allow new uses of existing airspace



Green Aviation – National Challenges

Fuel Efficiency

- In 2008, U.S. major commercial carriers burned 19.6B gallons of jet fuel. DoD burned 4.6B gallons
- At an average price of $3.00/gallon, fuel cost was $73B

Emissions

- 40 of the top 50 U.S. airports are in non-attainment areas that do not meet EPA local air quality standards for particulate matter and ozone
- The fuel consumed by U.S. commercial carriers and DoD releases more than 250 million tons of CO_2 into the atmosphere each year

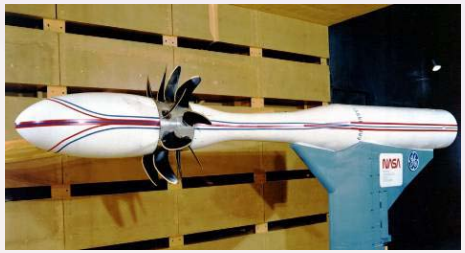
Noise

- Aircraft noise continues to be regarded as the most significant hindrance to NAS capacity growth.
- FAA's attempt to reconfigure New York airspace resulted in 14 lawsuits.
- Since 1980 FAA has invested over $5B in airport noise reduction programs
- Sonic boom over land limits economic viability of supersonic transport

Green Aircraft

X-48B

Open Rotor Propulsor
NASA/General Electric



NASA's revolutionary enabling technology

- Novel architectures for increased L/D
- Light weight structures
- Laminar flow to reduce drag

- Low NOx combustors
- Open rotors
- Alternative fuels

- Ultra-high bypass turbofans
- Airframe noise shielding using novel aircraft architectures

Benefits to the Public

Fuel burn savings:
Over 40% reduction from current aircraft

Emissions reduction:
Local air quality:
50% less NOx
Global climate:
40% less CO_2

Noise reduction
1/6th the objectionable ground noise footprint of current aircraft

Over 55 flights since July 2007 of the Hybrid Wing Body X-48B aircraft, in partnership with the U.S. Air Force, Boeing, and Cranfield Aerospace Ltd.

New ERA project in FY10 will mature and integrate these technologies at the systems level and test them in a relevant environment

Safety - National Challenges

Continued Safety with Existing Vehicles and Operations

- "Notwithstanding the challenging environment in which airlines operate, the U.S. airline industry has experienced the safest period in its history. [However,] we understand that we cannot become complacent and rest on our accomplishments. Aviation safety demands constant vigilance, review and improvement." (Air Transport Association statement to the Aviation Subcommittee of the Senate Commerce Committee, 4/10/2008.)

Improved Safety with Future Vehicles and Operations

- In 20 years time, 83% of the worldwide fleet in service will have been delivered new since 2008 (Boeing Commercial Aircraft Forecast Data)
  - Will they be durable?
  - Can they recover from upset conditions?
  - Can we sense potential failures and direct maintenance to them?
- The JPDO National Aviation Safety Strategic Plan has identified the need for safety-enhancing technologies for human-centered interfaces and airborne and ground-based systems (NASSP)
  - Will they use human performance, automation and 'net-centric' operations wisely?

Overcome Safety Barriers to Innovation

- The high cost of certification for new or upgraded systems is prohibitive
- The design and development of new capabilities contains a liability risk that is obstructive

NASA Aeronautics' contributions

"What could go wrong and how should the system respond?"

Continued Safety with Current Vehicles and Operations

- Understand aging processes and effects
- Make engines robust to icing
- Sense and avoid adverse conditions
- Design procedures and technologies for flight in or around hazardous conditions
- Support system resilience with adaptive technologies
- Piloted or automatic recovery from upset conditions

Improved Safety with Future Vehicles and Operations

(all of the above, plus…)

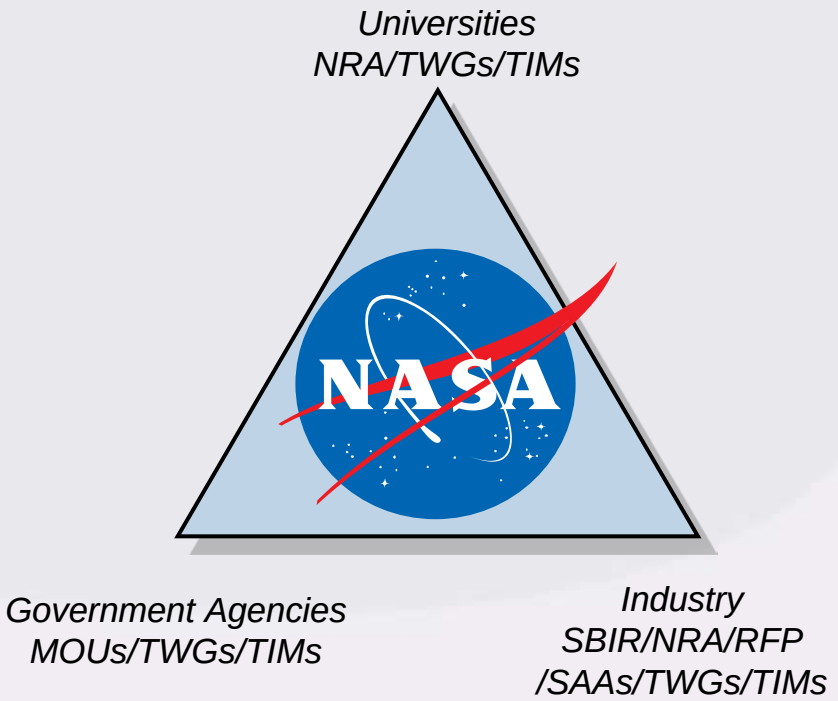
- Increase knowledge of emerging materials and structures
- Predict durability and crack formation of new materials with physics-based tools
- Prognostic safety analysis early in design
- Effective and robust human-automation systems
- Information-sharing that will 'make sense' to the pilot
- Evaluate safety using new sensor technologies and data mining methods – and determine how best to filter the information

Overcome safety barriers to innovation

- Prove the safety of flight-critical, software-intensive systems

Partnership Philosophy

- Help foster a collaborative research environment in which ideas and knowledge are exchanged across all communities.
- Maximize the return on investment to the taxpayer (our main stakeholder).
- In accordance with NASA's Space Act (as amended) and the National Aeronautics R&D Policy, we will provide for the widest practical and appropriate dissemination of our research results (consistent with national security and foreign policy).
- ARMD works under the umbrella of NASA's broad acquisition strategy that utilizes procurement mechanisms such as NASA Research Announcements (NRAs), Request For Proposals (RFPs), SBIR calls, and Space Act Agreements (SAAs).
- ARMD shares technical results and solicits partner insight through annual Technical Interchange meetings (TIMs) and Technical Working Groups (TWGs), journal articles and presentations at technical conferences.



NASA Research Announcement

NASA Research Announcement (NRAs) used to solicit proposals for foundational research in areas where we need to enhance our core capabilities.

- Grants, cooperative agreements or contracts
- 1-5 year performance period
- Competition open to academia, industry, non-profit organizations (individual or teams)
- Defined and managed at NASA centers by project team within our program areas
- Aligned with strategic goals and research portfolio
- 380 NRA awards issued since 2006

NRA Process

Research Opportunities in Aeronautics (ROA)

- Solicitations released through the Web-based NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES)
- Initial releases in March/April each year since 2006
- Amendments issued periodically through each year
- For 2009, announcement in April 2009 and 6 amendments (including ARRA funded)

ARMD website: http://www.aeronautics.nasa.gov/nra.htm

- NRA process description, past ROAs and proposal abstracts, weblinks

NSPIRES website: https://nspires.nasaprs.com/external/index.do

- ROA and amendments, registration, on-line tutorial, sign-up for email notification, proposers guidebook

Aeronautics and SBIR/STTR

Small Business Innovation Research (SBIR)
Small Business Technology Transfer (STTR)

PHASE I

- **Feasibility study**
- **$100K award**
- **6 months duration (SBIR)**
- **12 months duration (STTR)**
- **ARMD topics funded $8M in 2008**

PHASE II

- **Technology Development**
- **2-Year Award**
- **$600K (SBIR/STTR)**
- **ARMD topics funded $17.4M in 2008**

PHASE III

- **Technology Infusion/Commercialization Stage**
- **Use of non-SBIR Funds**
- **Aeronautics research funded through SBIR has evolved into FAA certified products on Boeing 787 and other aircraft and engines**

Factors Impacting ARMD Recommendations

- All Recommended proposals are aligned with Program goals and objectives.
- In addition to the standard SBIR evaluation factors, the proposed work is analyzed for alignment with current ARMD program goals and objectives
- The projects also look to how the proposal relates to currently funded efforts under the NRA.
- Consideration is given for proposals that can support multiple projects.
- ARMD considers how the proposal could also impact other MDs. This is most prevalent in topics such as materials research or thermal protection system development.

ARMD Contacts

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